

NASA Technical Memorandum 102646

**A Compendium of Sources of Fracture Toughness and
Fatigue Crack Growth Data for Metallic Alloys - Part IV**

C. Michael Hudson and John J. Ferrainolo

(NASA-TM-102646) A COMPENDIUM OF SOURCES OF
FRACTURE TOUGHNESS AND FATIGUE CRACK GROWTH
DATA FOR METALLIC ALLOYS, PART 4 (NASA)
38 p CSCL 11F

N90-21164

Unclass

G3/26 0277008

May 1990



National Aeronautics and
Space Administration

Langley Research Center
Hampton, Virginia 23665-5225

In references 1 through 3, Hudson and Seward presented the first three parts of their compendium of sources of fracture toughness and fatigue crack growth data. Because of the many requests received for copies of these references, Hudson and Ferrainolo have compiled Part IV of the compendium. Part IV concentrates on both technical reports and technical journals published in 1981 and 1982. The reports and journals published before 1981 were extensively reviewed for references 1 through 3. The reports and journals published after 1982 will hopefully be reviewed for subsequent parts of the compendium. The reader should note that none of the references cited in references 1 through 3 are included herein.

Table I lists the journals reviewed and the periods covered during this review. Table II lists the abbreviations used for the various references. Table III lists the materials for which data were located, and the corresponding references.

Where available, accession numbers have been included with the references. These accession numbers (which are listed in brackets at the ends of the references) are the code numbers for ordering these reports. The sources for ordering these reports are listed as follows:

Accession Number

Source

xxAxxxxx

American Institute for Aeronautics and Astronautics
555 West 57th Street (12th floor)
New York, NY 10019 USA
(212) 247-6500

AD-xxxxxxxL

Defense Technical Information Center
Defense Logistics Agency
Cameron Station
Alexandria, VA 22314 USA
(202) 274-7633

AD-xxxxxxx

and

PBxx-xxxxxx

National Technical Information Service
5285 Port Royal Road
Springfield, VA 22161 USA
(703) 487-4650

xxNxxxxx

and

xxVxxxxx

NASA
Scientific and Technical Information Facility
P. O. Box 8757
B.W.I. Airport, MD 21240 USA
(301) 859-5300

Table I. Journals Reviewed, Over Periods Shown

ASME - Journal of Engineering Materials and Technology	Jan. 1981 - Oct. 1982
ASME - Journal of Engineering for Industry	Feb. 1981 - Nov. 1982
ASME - Journal of Pressure Vessel Technology	Feb. 1981 - Nov. 1982
Cryogenics	Jan. 1981 - Dec. 1982
Engineering Fracture Mechanics	1981 - 1982
Experimental Mechanics	Jan. 1981 - Dec. 1982
Fatigue of Engineering Materials and Structures	1981 - 1982
International Journal of Fatigue	Jan. 1979 - Oct. 1982
International Journal of Fracture	Feb. 1981 - Dec. 1982
Journal of Material Science	Jan. 1981 - Dec. 1982
Metals Science	Jan. 1981 - Dec. 1982
Metallurgical Transactions A	Jan. 1981 - Dec. 1982

Table II. Abbreviations

AFFDL	Air Force Flight Dynamics Laboratory Wright-Patterson Air Force Base, OH 45433 USA
AFML	Air Force Materials Laboratory Wright-Patterson Air Force Base, OH 45433 USA
AGARD	Advisory Group for Aeronautical Research and Development 7 rue Ancelle, 92200 Neuilly Sur Seine, France 1.47.38.57.00
AIAA	American Institute of Aeronautics and Astronautics 370 L'Enfant Promenade, S.W. Washington, DC 20024 USA (202) 646-7400
AIME	American Institute of Mining, Metallurgical and Petroleum Engineers 345 East 47th Street New York, NY 10017 USA (212) 705-7695

AMMRC	Army Materials and Mechanics Research Center Watertown, MA 02172 USA
ASME	American Society of Mechanical Engineers 345 East 47th Street New York, NY 10017 USA (212) 705-7722
ASTM	American Society for Testing and Materials 1916 Race Street Philadelphia, PA 19103 USA (215) 299-5400
CRYO	Cryogenics
EFM	Engineering Fracture Mechanics
EM	Experimental Mechanics
FEMS	Fatigue of Engineering Materials and Structures
IJF	International Journal of Fracture
IJOF	International Journal of Fatigue
JEMT	Journal of Engineering Materials and Technology

JMS **Journal of Materials Science**

JPVT **Journal of Pressure Vessel Technology**

MEQ **Metals Engineering Quarterly**

MS **Metal Science**

MT **Metallurgical Transactions**

NASA **National Aeronautics and Space Administration**
Scientific and Technical Information Office
Washington, DC 20546 USA
(202) 755-1089

NRL **Naval Research Laboratory**
Washington, DC 20375 USA

SAE **Society of Automotive Engineers**
400 Commonwealth Drive
Warrendale, PA 15096 USA
(412) 776-4841

WJ **Welding Journal**

**Table III. Materials and References Cited for Fracture Toughness
and Fatigue Crack Growth Data**

A.1 Aluminum and Its Alloys; Fracture Toughness

A201-T7	4	BS L97	5
DTD 502A	6	DTD 5120	5
PA6	6	2014-T6	7
2014-T451	8	2014-T651	8
2020-T6	9	2020-T651	10
2024-T3	11-20	2024-T8	11,18
2024-T351	8,21-25	2048-T851	8,23,26
2218-T87	27	2219-T37	8
2219-T87	8,28	2219-T851	17,28-32
2419-T851	33	2618-T6	15
2618-T651	34	5083-H131	35
5456-H117	36	5456-H321	21
6061-T651	8,25,37,38	7010-T7351	39,40
7010-T7651	24,39-41	7010-T73651	39-44
7049-T73	8	7050-T736	8
7050-T3651	26	7050-T73651	4,8,23,24,45
7075-T6	12-14,16,17,20,32,46-48		
7075-T73	15	7075-T351	24
7075-T651	8,11,13,18,21,22,25,26,28,49		
7075-T7351	8,12,14,23,26,45,50		
7075-T7651	8,22	7079-T6	51,52

7079-T651	8	7175-T66	8
7178-T651	8,22,53,54	7475-T351	37
7475-T651	23,26,41,55	7475-T761	16,20
7475-T7351	23,24,26,41,56	7475-T7651	41

A.2 Aluminum and Its Alloys; Fatigue Crack Growth

Aluminum, pure	57,58	A357-T6	42
BS 1490.LM30	59	DTD 5050	60
DTD 5120	5	L65	57
RR58	59,61	1100-0	58,62
2017-T4	63,64	2020-T651	10
2021-T6	65,66		
2024-T3	15,66-78	2024-T4	62
2024-T351	23,79-83	2024-T851	23,27
2048-T351	84	2048-T851	84
2124-T4	62	2124-T851	23,85,86
2219-T851	29,80,83,88-95	2618-T651	34,96,97
2618-T851	81	5083-0	98
5456-H343	99	6061-T6	81
7010-T73	44	7010-T7351	40
7010-T7651	40	7010-T73651	40,42-44
7050-T73	44	7050-T73651	23,81
7075-T6	46,63,64,66-68,71-73,100-107		
7075-T7	66	7075-T73	85,108
7075-T651	96,109	7075-T7351	23
7079-T6	51	7091-T7	66

7175-T7351	81	7178-T651	53
7475-T651	23,55,76	7475-T7351	23,44,81

B.1 Iron and Steel Excepting Stainless Steel; Fracture Toughness

ASTM A36	110-113	ASTM A106	114
ASTM A217	38	ASTM A302	115-117
ASTM A353	118	ASTM A387	119-124
ASTM A441	111	ASTM A469	38
ASTM A470	125	ASTM A508	25,110,117,126-137
ASTM A516	117,122,131,138,139	ASTM A517	140
ASTM A533	25,36,110,115,117,126,127,129, 131,132,134,140-154		
ASTM A537	155	ASTM A540	38,131
ASTM A542	119-124,138,156-158		
ASTM A553	118,159,160	ASTM A588	112
AISI 1018	117,146,151	AISI 4130	161,162
AISI 4140	154,163	AISI 4142	164
AISI 4330	161	AISI 4335	165
AISI 4340	8,13,25,27,33,115,154,161,166-171		
AISI 9310	172	AISI 52100	173,174
ABS-AH36	175	ABS-B	176
ABS-C	140,176	ABS-CS	175
ABS-DS	175	ABS-E	175
ABS-EH	140,175	AF 1410	177
AM 355	7	BS 4360	178-184
CBS 600	172	CBS 1000	172

D6AC	8,21	E7016	178
E8018	178	En 30A	185
En 32B	186,187	En 50	188
H-11	8	HT-9	189,190
HY-80	115,191	HY-100	192
HY-130	36,115,193-195	Incoloy 800	196
Iron, pearlitic gray	197	M-2	198,199
N-80	200	Steel, mild	115,129,145,201
VASCO-MA	199	X-2	172
X-53	172	X-65	202
X-70	115	2-1/4Cr-1Mo	25
9Ni	159	9Cr-1Mo	190
9Ni-4Co-0.2C	8,29,30	9Ni-4Co-0.3C	8
12Ni-0.2Ti	204	12Ni-xTi	205
12Ni-1Mo-0.2Ti	204	18Ni	13
300M	8,12,14,21,138,157,161,206		

B.2 Iron and Steel Excepting Stainless Steel; Fatigue Crack Growth

ASTM A36	207	ASTM A302	208
ASTM A333	208,209	ASTM A387	119,157,210
ASTM A469	211	ASTM A470	125,212
ASTM A508	208,213-216	ASTM A516	122,138,208,217,218
ASTM A533	98,208,213,219-228		
ASTM A542	119,122,138,156-158,210,218,229,230		
ASTM A572	231	AISI 1015	79,232
AISI 1018	233,234	AISI 1020	233,235,236

AISI 10B35	234	AISI 1045	234
AISI 4140	237, 238	AISI 4340	94, 239
AISI 9310	240	AF 1410	177
AM 350	68	BS 15	61
BS 3100	241	BS 4360	59, 236, 242-248
En 3	249	En 24	249, 250
En 52	188	G40.11	225, 232, 251, 252
HP-9Ni-4Co-0.30C	253	HSLA	254, 255
HT-80	248, 256, 257	HY-80	258
HY-130	216, 248, 258-262	Incoloy 800	196, 263
Iron, gray cast	57, 249	Iron, sg	264
JIS SM50B	64	JIS SPCC	64
LR-DH	265	Man-Ten	32
N-80	200	SM50A	248
SM58Q	248	SNCM2	266
Steel, concrete reinforcing	267	Steel, mild	57, 98, 233, 268, 269
Steel, rail	270	X-60	217
X-70	271	2-1/4Cr-1Mo	272
2-1/2Ni	255, 273	4Ni	255
9Cr-1Mo	272	10Ni	32, 80, 83, 274
18Ni(250)	275	18Ni(300)	275
300M	96, 108, 138, 157, 206, 210		

C.1 Stainless Steel; Fracture Toughness

AISI 304	25,276-279	AISI 308	280
AISI 316	25,115,145,279-281	AISI 316L	282
AISI 403	38	AISI 440	33
A286	283,284	AM 355	13,285,286
ASM 5737	287	FV 520	286
HT-9	288	JBK-75	283,284
Kromarc	283,284	PH13-8Mo	8
PH15-5	8	PH15-7Mo	8,286
PH17-4	8,13,286,289,290	PH17-7	8,13,286
12Cr	291		

C.2 Stainless Steel; Fatigue Crack Growth

AISI 304	219,223,266,292-302	AISI 316	34,96,97,189,223,224, 297,300,301,303-307
AISI 316L	282	AISI 403	308
A286	274,309	HT-9	272
X6 CrNi 18	302		

D.1 Titanium and Its Alloys; Fracture Toughness

Ti-0.2Pd	310	Ti-2.5Cu	310
Ti-3Al-2.5V	36,285	Ti-3Al-8V-6Cr-4Zr-4Mo	311
Ti-3Al-10V-2Fe	312	Ti-4Al-4Mo-2Sn-0.5Si	310,313
Ti-4Al-4Mo-4Sn-0.5Si	310	Ti-4.5Al-5Mo-1.5Cr	314

Ti-5Al-2.5Sn	8,27,310,315		
Ti-5.5Al-3.5Sn-3Zr-1Nb-0.25Mo-0.3Si	310		
Ti-6Al-2Zr-2Sn-2Mo-2Cr	312	Ti-6Al-2Sn-4Zr-6Mo	8,312,316
Ti-6Al-4V	8,12-14,29,30,45,46, 56,285,310,313-323		
Ti6Al-4Zr-2Sn-2Mo	310	Ti-6Al-5Zr-0.5Mo-0.2Si	310,313
Ti-6Al-6V-2Sn	8,13,310,316,318, 324,325		
Ti-8Al-1Mo-1V	8	Ti-11Sn-4Mo-2.25Al-0.2Si	310
Ti-11Sn-5Zr-2.25Al-1Mo-0.2Si	310,313	Ti-11.5Mo-6Zr-4.5Sn	310
Corona 5	42,316	IMI 110	310
IMI 115	310	IMI 125	310
IMI 130	310	IMI 155	310
IMI 160	310		

D.2 Titanium and Its Alloys; Fatigue Crack Growth

Titanium, pure	326,327	Ti-5Al-4Mo	328
Ti-6Al-2Cb-1Ta-0.8Mo	216,329	Ti-6Al-2Sn-4Zr-2Mo	189,330-332
Ti-6Al-2Sn-4Zr-2Mo-0.1Si	333		
Ti-6Al-4V	216,319,320,329, 330,334-340		
Ti-6Al-2V-2Sn	329,341,342		
Ti-8Al-1Mo-1V	68,319,329,335,337		
Ti-30Mo	343		

E.1 Nickel and Its Alloys; Fracture Toughness

Inconel ELA	38	Inconel 718	285,344,345
Inconel 750	346	Inconel 792	42
Inconel 901	347	Nimocast 713LC	345
Nimocast 738LC	345	Nimocast 739	345
Nimocast 793	345	Nimonic 90	345
Nimonic 901	345		

E.2 Nickel and Its Alloys; Fatigue Crack Growth

Nickel, pure	57,249,348	Astroloy	349,350
B-1900 + Hf	351	Hastelloy X	307,352
Inconel 100	298,299,353,354	Inconel 600	355
Inconel 718	251,289,293,303,344,356-359		
Inconel 738	360-364	Inconel 750	223,350,365
Inconel 792	42	Inconel 939	362-364
Mar-M200 + Hf	351	Monel	57,348
NASA II B-7	353	Nimonic API	366,367
Nimonic 115	350,368	Rene' 95	353,369
Udimet 700	251,370	Waspaloy	298,299,350,353

F.1 Copper and Its Alloys; Fracture Toughness

No References

F.2 Copper and Its Alloys; Fatigue Crack Growth

Copper, pure	57,348,371,372	Cu-2Al	371
Cu-4Al	371	Cu-8Al	371
Cu-9Al	373	Phosphor Bronze	57,348
60/40 Brass	57,249,348	70/30 Brass	96

G.1 Magnesium and Its Alloys; Fracture Toughness

No References

G.2 Magnesium and Its Alloys; Fatigue Crack Growth

AM 503	57	IMV6	374
MA 12	250,374	ZW1	57

H. Beryllium and Its Alloys

No References

I. Molybdenum and Its Alloys

No References

J.1 Zirconium and Its Alloys; Fracture Toughness

Zirconium, pure	375	Zr-2.5Nb.	375
-----------------	-----	-----------	-----

J.2 Zirconium and its Alloys; Fatigue Crack Growth

No References

K.1 Cobalt and Its Alloys; Fracture Toughness

No References

K.2 Cobalt and Its Alloys; Fatigue Crack Growth

COTAC

341

Co33Ni

376

L. Uranium and Its Alloys

No References

M.1 Tungsten and Its Alloys; Fracture Toughness

No References

M.2 Tungsten and Its Alloys; Fatigue Crack Growth

93W

377

REFERENCES

1. C.M. Hudson and S.K. Seward, IJF, 14 (1978) R151-R184 [78A47590].
2. C.M. Hudson and S.K. Seward, IJF, 20 (1982) R59-R117.
3. C.M. Hudson and S.K. Seward, IJF, 39 (1989) R43-R63.
4. W.T. Highberger, G.V. Scarich and G.R. Chanani, Materials 1980, 12, Society for the Advancement of Material and Process Engineering (1980) 554-562 [81A43601].
5. D. Rhodes, J.C. Radon and L.E. Culver, FEMS, 4 (1981) 49-63 [81A48508].
6. J.R. Klepaczko, JEMT, 104 (1982) 29-35.
7. T.W. Orange, NASA TP 1753 (1980) [81N11417].
8. C.S. Carter, Practical Applications of Fracture Mechanics, AGARDograph No. 257 (1980) 9-1 - 9-24 [82N19571].
9. D. Webster, G. Wald and W.S. Cremens, MT, 12A (1981) 1495-1502.
10. R.C. Malcolm, A.K. Vasudevan, R.J. Bucci and P.E. Bretz, Alcoa Report, Contract No. N00019-79-C-0258 (1981) [82N30385].
11. H.F. de Jong, Delft University of Technology Report LR-294 (1980) [81N28492].
12. S.K. Imtiaz and B.L. Smith, Society of Automotive Engineers Paper 810594 (1981) [81A42753].
13. D.W. Levinson, International Advances in Nondestructive Testing, 7 (1981) 1-11 [81A38666].
14. B.L. Smith and S.Y. Lee, Society of Automotive Engineers Report 810593 (1981) [81A42752].
15. A. Nappi, International Conference on Aeronautical Fatigue Document No. 1091 (1978) 101-109 [80N70782].
16. K-H. Schwalbe and W. Setz, Journal of Testing and Evaluation, 9 (1981) 182-194 [81A41161].
17. A. Frediani, EFM, 14 (1981) 289-322 [81A28978].
18. H.F. de Jong, EFM, 14 (1981) 539-547.
19. J. Baram and M. Rosen, EFM, 15 (1981) 477-486 [82A15514].
20. T. Fett and G. Marci, IJF, 20 (1982) R121-R124.

21. V. Weiss, Y. Kasai, K. Liu, W. Sanford and K. Sieradzki, Syracuse University Report MS-VW-1713-F1275 (1975) [81N75956].
22. M.D. Campbell and G.L. O'Barr, General Dynamics Convair Division Report GDC-ERR-1404 (1969) [81N74397].
23. G.R. Chanani, I. Telesman, P.F. Bretz and G.V. Scarich, Northrop Corporation Report NOR 82-54 (1982) [82N31717].
24. D. Munz, EFM, 15 (1981) 231-236 [82A14316].
25. J.D. Landes, IJF, 17 (1981) R47-R51.
26. J.R. Pickens, JMS, 16 (1981) 1437-1457.
27. A.F. Liu and H.P. Kan, JEMT, 104 (1982) 107-114 [82A32116].
28. M.K. Iseng and H.L. Marcus, EFM, 16 (1982) 895-903 [82A40074].
29. J.B. Chang, M. Szamosi and E. Klein, Fracture and Failure, American Society for Metals (1981) 35-54 [82V10583].
30. R.M. Engle, Jr., STP 687, American Society for Testing and Materials (1979) 74-88 [81A10351].
31. C.M. Hudson and P.E. Lewis, STP 687, American Society for Testing and Materials (1979) 113-128 [81A10351].
32. G. Glinka, IJOF, 4 (1982) 59-66 [82A31496].
33. L.M. Barker, TerraTek Report TR80-11 (1980) [81N21191].
34. C. Bathias, FEMS, 4 (1981) 1-13.
35. J.R. Pickens, D. Venables, G.D. Davis and J.R. Gordon, Martin Marietta Corporation Report MML TR 82-9 (1982) [82N32473].
36. M.G. Vassilaros and J.A. Joyce, David Taylor Naval Ship Research and Development Center Report DTNSRDC-81/029 (1981) [82N16218].
37. R.V. Guest, Material and Process Applications - Land, Sea, Air, Space, Society for the Advancement of Material and Process Engineering (1981) 536-542 [81A44369].
38. A. Zahoor and P.C. Paris, JEMT, 103 (1981) 46-54 [81A23005].
39. W.G.J.'t Hart and L. Schra, National Aerospace Laboratory Report, NLR TR 79017U (1979) [81N20269].
40. R.J.H. Wanhill, W.G.J.'t Hart and L. Schra, IJOF, 1 (1979) 205-209 [80A30771].
41. C.Q. Chen and J.F. Knott, MS, 15 (1981) 357-364.

42. O. Deel, AFWAL-TR-80-4103 (1980) [81N25194].
43. R.R. Cervay, AFWAL-TR-81-4140 (1981) [82N25542].
44. R.R. Cervay, AFWAL-TR-80-4094 (1980) [81N16220].
45. H. Fuhring, 5th International Conference Fracture, Cannes, France, 4 (1982) 1823-1832 [82V12048].
46. J. Schijve, Delft University of Technology Report LR-327 (1981) [82N19591].
47. J. Baram and M. Rosen, EFM, 15 (1981) 487-494 [82A15514].
48. V.K. Pujari, I. Finnie and F.E. Hauser, EM 21 (1981) 234-239 [81A36636].
49. W.M. McGee and T.M. Hsu, EFM, 14 (1981) 595-606 [81A38586].
50. J. Eschweiler and D. Munz, IJF, 20 (1982) R131-R133.
51. S.R. Swanson, F. Cicci and W. Hoppe, STP 415, American Society for Testing and Materials (1967) 312-360 [82V13203].
52. T.T. Shih, EFM, 14 (1981) 821-832.
53. A.W. Bowen and P.J.E. Forsyth, Materials Science and Engineering, 49 (1981) 141-154 [81A42593].
54. P.J.E. Forsyth and A.W. Bowen, IJOF, 3 (1981) 17-25 [81A25773].
55. D.L. Dicus, NASA TM 84477 (1982) [82N25370].
56. D. Munz, European Space Agency Technical Translation ESA-TT-649 (1980) [81N23505].
57. L.P. Pook, Developments in Fracture Mechanics - 1, Applied Science Publishers (1979) 183-220 [81A48576].
58. P.K. Liaw and M.E. Fine, MT, 12A (1981) 1927-1937.
59. D. Rhodes, J.K. Musuva and J.C. Radon, EFM, 15 (1981) 407-419 [82A15508].
60. D.W. Cruickshanks-Boyd, Royal Aircraft Establishment Report RAE TR 76012 (1976) [82N77138].
61. J.C. Radon, P.M.S.T. de Castro and L.E. Culver, Second European Colloquium on Fracture, Darmstadt, October 9-11, 1978 (1978) 311-336 [81V17067].
62. J. McKittrick, P.K. Liaw, S.I. Kwun and M.E. Fine, MT, 12A (1981) 1535-1539.

63. A. Otsuka, K. Mori, T. Ohshima and S. Tsuyama, 5th International Conference Fracture, Cannes, France, 4 (1982) 1851-1858 [82V12048].
64. A. Otsuka, K. Mori, S. Tsuyama and Y. Sumiya, Analytical and Experimental Fracture Mechanics, Sijthoff and Noordhoff (1981) 375-386 [81V28137].
65. S. Suresh, FEMS, 5 (1982) 133-150 [83A17894].
66. A.K. Vasudevan and S. Suresh, MT, 13A (1982) 2271-2280 [83A16005].
67. J.R. Rice, STP 415, American Society for Testing and Materials (1967) 247-309 [82V13203].
68. D.P. Wilhem, STP 415, American Society for Testing and Materials (1967) 363-380 [82V13203].
69. J. Schijve, STP 415, American Society for Testing and Materials (1967) 415-457 [82V13203].
70. H.H. van der Linden, National Aerospace Laboratory Report NLR TR 79121U (1979) [81N31589].
71. D.L. Jones and J. Eftis, Air Force Office of Scientific Research Report AFOSR-TR-81-0856 (1981) [82N19587].
72. G.S. Jost and L.R. Gratzer, Aeronautical Research Laboratories (Australia) Structures Report 387 (1981) [82N23551].
73. A.U. de Koning and H.H. van der Linden, National Aerospace Laboratory Report NLR MP 81023U (1981) [82N28685].
74. L. Schwarmann, Proceeding of the Twelfth International Council of the Aeronautical Sciences (1980) 713-722 [81A11663].
75. G. Cavallini, International Conference on Aeronautical Fatigue Document No. 1091 (1978) 155-164 [80N70782].
76. R.J. H. Wanhill, Proceedings of the Twelfth International Council on the Aeronautical Sciences (1980) 645-651 [81A11657].
77. J. Schijve, Nederlandse Vereniging voor Luchtvaarttechniek, Yearbook 1979, (1979) [81A24939].
78. J. Schijve, EFM, 14 (1981) 461-465.
79. B.N. Leis and T.P. Forte, STP 743, American Society for Testing and Materials (1981) 100-124 [82V11353].
80. R.J. Bucci, STP 738, American Society for Testing and Materials (1981) 5-28 [81V27201].
81. D. Aliaga and E. Budillon, AGARD Conference Proceedings AGARD-CP-316 (1981) 3-1 - 3-12 [82N17344].

82. R.R. Cervay, AFWAL-TR-82-4025 (1982) [82N32469].
83. R.J. Bucci, STP 687, American Society for Testing and Materials (1979) 47-73 [81A10351].
84. R.J. Asaro, L. Hermann and J.M. Baik, MT, 12A (1981) 1133-1135.
85. J.J. Ruschau, AFWAL-TR-81-4011 (1981) [81N26499].
86. T.C. Lindley and P. McIntyre, The Measurement of Crack Length and Shape During Fracture and Fatigue, Engineering Materials Advisory Services, Ltd. (1980) 285-344 [81V20024].
87. Deleted.
88. J.B. Chang, R.M. Engle, and J. Stolpestad, STP 743, American Society for Testing and Materials (1981) 3-27 [82V11353].
89. C.M. Hudson, STP 748, American Society of Testing and Materials (1981) 41-52 [82A20508].
90. J.C. Newman, NASA TM 81942 (1981) [81N19486].
91. M.S. Miller and J.P. Gallagher, STP 738, American Society for Testing and Materials (1981) 205-251 [81V27201].
92. J.B. Chang, STP 687, American Society for Testing and Materials (1979) 156-167 [81A10351].
93. L. Albertin and S.J. Hudak, Jr., STP 733, American Society for Testing and Materials (1981) 187-201 [81A47858].
94. R.P. Wei and G.W. Simmons, IJF, 17 (1981) 235-247 [81A33524].
95. W.L. Morris, M.R. James and O. Buck, MT, 12A (1981) 57-64 [81A22252].
96. J. Lanteigne and J-P. Bailon, MT, 12A (1981) 459-466 [81A27472].
97. C. Amzallag, P. Rabbe, C. Bathias, D. Benoit and M. Truchon, STP 738, American Society for Testing and Materials (1981) 29-44 [81V27201].
98. A.F. Blom, Aeronautical Research Institute of Sweden Report FFA TN 1982-06 (1982) [82N30580].
99. H.P. Chu, J.A. Hauser and J.R. Sikora, STP 761, American Society for Testing and Materials (1982) 345-372 [82V27512].
100. A.U. de Koning, STP 743, American Society for Testing and Materials (1981) 63-85 [82V11353].

101. G.R. Yoder, L.A. Cooley and T.W. Crooker, NRL Memo Report 4787 (1982) [82N28417].
102. I.E. Figge and J.C. Newman, Jr., STP 415, American Society for Testing and Materials (1967) 71-93 [82V13203].
103. A.U. de Koning, National Aerospace Laboratory Report NLR MP 80006 U (1980) [81N21401].
104. A.K. Miller, Leland Stanford Junior University Report SU-DMS-82-R-3 (1982) [82N33511].
105. M. Khobaib and C.T. Lynch, Material and Process Applications - Land, Sea, Air, Space, Society for the Advancement of Materials and Process Engineering, 26 (1981) 52-64 [81A44369].
106. J. Lankford, FEMS, 5 (1982) 233-248 [83A17674].
107. P.D. Hobson, FEMS, 5 (1982) 323-327 [83A27855].
108. R. Badaliane, Mixed-Mode Crack Propagation, Sijthoff and Noordhoff (1981) 77-98 [81V28149].
109. M.M. Ratwani, D.P. Wilhem, J.P. Carter, H.P. Kan and M. Kaplan, Journal of Aircraft, 18 (1981) 206-212 [81A31599].
110. R. Roberts, J.W. Fisher, G.R. Irwin, K.D. Boyer, H. Hausmann, G.V. Krishna, V. Morf, R.E. Slockbower and J. Nishanian, 5th International Conference Fracture, Cannes, France, 5, (1982) 2101-2108 [82V12048].
111. C.B. Kendrick, R.D. Smith, and W.F. Crozier, California Department of Transportation Report FHWA-CA-TL-80/11 (1980) [81N25208].
112. J.F. Sovak, WJ, 60 (1981) 269s-272s.
113. E.J. Ripling and P.B. Crosley, WJ, 61 (1982) 65s-75s.
114. J. Mucci, Department of Energy Report DOE/ET/26214-T1 (1980) [81N29454].
115. P. Brozzo and G. Buzzichelli, Analytical and Experimental Fracture Mechanics, Sijthoff and Noordhoff (1981) 45-79 [81V28137].
116. F.J. Loss, Analytical and Experimental Fracture Mechanics, Sijthoff and Noordhoff (1981) 291-304 [81V28137].
117. F.J. Witt, Westinghouse Electric Corporation Report WCAP-9706 (1980).
118. R.D. Stout and A.W. Pense, Gas Research Institute Report GRI 80/0037 (1981) [82N11202].
119. S. Suresh, G.F. Zamiski and R.O. Ritchie, STP 755, American Society for Testing and Materials (1982) 49-67.

120. J.D. Landes and D.E. McCabe, STP 798, American Society for Testing and Materials (1982) 68-92.
121. R. Viswanathan and R.I. Jaffee, Electric Power Research Institute Report EPRI-RD-2143-SR (1981) [83N17707].
122. S. Suresh and R.O. Ritchie, Lawrence Berkeley Laboratory LBL-13583 (1981) [82N29631].
123. D.E. McCabe and J.D. Landes, Electric Power Research Institute Report EPRI-AP-1508 (1980) [81N15081].
124. R. Viswanathan and R.I. Jaffee, JEMT, 104 (1982) 220-226.
125. I. Roman, K. Ono and A.S. Tetelman, EFM, 14 (1981) 155-163 [81A17488].
126. R.L. Jones, T.U. Marston, S.W. Tagart, D.M. Norris and R.E. Nickell, STP 761, American Society for Testing and Materials (1982) 28-46 [82V27512].
127. W.P.A. Belcher and S.G. Druce, United Kingdom Atomic Energy Authority - Harwell, Report No. AERE-R-10300 (1981) [83N15454].
128. C.W. Marschall and A.R. Rosenfield, 5th International Conference Fracture, Cannes, France, 5 (1982) 2467-2475 [82V12048].
129. A. Pineau, 5th International Conference Fracture, Cannes, France, 2 (1982) 553-577 [82V12048].
130. B. Marandet, G. Philippean and G. Sanz, 5th International Conference Fracture, Cannes, France, 1 (1982) 375-383 [82V12048].
131. H. Susukida, M. Satoh, K. Ando, Y. Sakaguchi, A. Fukuhara, J. Tanabe and Y. Ando, 4th International Conference on Pressure Vessel Technology, 1 (1980) 361-368 [81V31180].
132. S.G. Druce, B. L. Eyre and W.P.A. Belcher, Atomic Energy Research Establishment Report AERE-R-8969 (1978).
133. S. Rao, Studsvik Energiteknik AB Report STUDSVIK-E1-80/85 (1980) [82N27793].
134. G.T. Hahn, R.G. Hoagland, J. Lereim, A.J. Markworth and A.R. Rosenfeld, STP 711, American Society for Testing and Materials (1980) 289-320 [81A18026].
135. A.R. Rosenfeld and D.K. Shetty, EFM, 14 (1981) 833-842.
136. J.C. Lautridou and A. Pineau, EFM, 15 (1981) 55-71.
137. R.D. Cheverton, S.E. Bolt, P.P. Holz and S.K. Iskander, EM, 21 (1981) 155-162.

138. R.O. Ritchie, S. Suresh and J. Toplosky, Lawrence Berkeley Laboratory Report LBL-13421 (1981) [82N28423].
139. S. Banerjee, EFM, 15 (1981) 343-390 [82A15506].
140. A.W. Pense, Lehigh University Report SR-1265 (1981) [AD-A117059].
141. D.M. Norris, J.E. Reaugh and W.L. Server, STP 743, American Society for Testing and Materials (1981) 207-217 [82V11353].
142. G. Angelino and C. Fossati, 5th International Conference Fracture, Cannes, France, 5 (1982) 2345-2352 [82V12048].
143. H. Nakamura, H. Kobayashi, T. Kodaira and H. Nakazawa, 5th International Conference Fracture, Cannes, France, 2 (1982) 817-824 [82V12048].
144. G.T. Hahn, R.G. Hoagland and R.D. Cheverton, 5th International Conference Fracture, Cannes, France, 2 (1982) 1043-1050 [82V12048].
145. B.W. Pickles, Second European Colloquium on Fracture, Darmstadt, October 9-11, 1978 (1978) 130-143 [81V17067].
146. D.L. Marriott, R.P.G. Anderson and G.G. Garrett, Engineering Applications of Fracture Analysis, Pergamon Press (1980) 337-352 [81V13795].
147. S.J. Garwood and G.L. Archer, 4th International Conference on Pressure Vessel Technology, 1 (1980) 93-101 [81V31180].
148. F.J. Loss, Fracture Mechanics of Ductile and Tough Materials and Its Application to Energy Related Structures, Martinus Nijhoff Publishers (1981) 121-130 [82V17290].
149. F. Nilsson, Royal Institute of Technology (Sweden) Report TRITA-HFL-0026 (1979) [81N14323].
150. M.P. Gomez, R.M. McMeeking and J.M. Parks, Washington University Technology Associates Report WUTA 7972-04 (1979) [81N14357].
151. P.B. Crosley and E.J. Ripling, Electric Power Research Institute Report EPRI-NP-1225 (1979) [81N15409].
152. A.S. Kobayashi, M. Ramulu and S. Mall, JPVT, 104 (1982) 25-30.
153. W.A. Logsdon, EFM, 16 (1982) 757-767.
154. E.J. Ripling, J.H. Mulherin and P.B. Crosley, MT, 13A (1982) 657-664.
155. J.F. Sovak, J.W. Caldwell and A.K. Shoemaker, U. S. Steel Corporation Report SSC-303 (1981) [AD-A117057].

156. S. Suresh and R.O. Ritchie, 5th International Conference Fracture, Cannes, France, 4 (1982) 1873-1880 [82V12048].
157. R.O. Ritchie, S. Suresh and J. Toplosky, Department of Energy Report DOE/ER/10389 (1980) [81N14066].
158. S. Suresh, G.F. Zamiski and R.O. Ritchie, MT, 12A (1981) 1435-1443.
159. H.J. Kim, C.K. Syn and J.W. Morris, Jr., Advances in Cryogenic Engineering Materials, 28 (1982) 873-882 [83N72189].
160. R.M. Bruscato, WJ, 60 (1981) 113s-120s.
161. M.S. Bhat and V.F. Zackay, Fracture and Failure, American Society for Metals (1981) 65-109 [82V10583].
162. P. Nguyen-Duy and S. Bayard, JEMT, 103 (1981) 55-61 [81A23006].
163. W.J.D. Shaw and I. LeMay, 5th International Conference Fracture, Cannes, France, 2 (1982) 613-622 [82V12048].
164. M.S. Soo Hoo, Sandia National Laboratories SAND-81-0884 (1981) [82N12480].
165. J.H. Underwood and J.A. Kapp, Army Armament Research and Development Command Report ARLCB-TR-80011 (1980) [81N12456].
166. H. Kobayashi, K. Hirano, H. Kayakabe and H. Nakazawa, 5th International Conference Fracture, Cannes, France, 4 (1982) 1909-1916 [82V12048].
167. Z. Bilek, 5th International Conference Fracture, Cannes, France, 2 (1982) 1027-1034 [82V12048].
168. C.F. Hickey, Jr., A.A. Anctil and R. Chait, Fracture Toughness of Wrought and Cast Steels, MPC-13, The American Society of Mechanical Engineers (1980) 219-229 [81V16234].
169. C.N. Sasty, W.E. Wood and K.B. Das, Society for the Advancement of Material and Process Engineering Quarterly, 12 (1981) 27-32 [81A23965].
170. K.P. Datta and W.E. Wood, STP 733, American Society for Testing and Materials (1981) 150-165 [81A47857].
171. N. Tsangarakis, EFM, 16 (1982) 569-572.
172. D.E. Diesburg, AAMRC TR 82-24 (1982) [82N32467].
173. B.L. Averbach, 5th International Conference Fracture, Cannes, France, 2 (1982) 623-630 [82V12048].
174. G. Krauss, Wear and Fracture Prevention, American Society for Metals (1981) 147-161 [82V17274].

175. P.O. Metz, Fracture Toughness of Wrought and Cast Steels, MPC-13, The American Society of Mechanical Engineers (1980) 69-218 [81V16234].
176. ANON., National Materials Advisory Board Report NMAB-360 (1981) [81N29207].
177. S.D. Antolovich, AFML-TR-79-4209 (1980) [81N12453].
178. H.G. Pisarski and M.G. Dawes, Analytical and Experimental Fracture Mechanics, Sijthoff and Noordhoff (1981) 595-614 [81V28137].
179. T.F. Gulvin, P. Terry and S.E. Webster, 4th International Conference on Pressure Vessel Technology, 1 (1980) 71-84 [81V31180].
180. C. Ruiz and Y.P. Phang, University of Oxford Report OUEL-1367/81, Part 2, (1981) [82N17541].
181. I.C. Mayes and T.J. Baker, FEMS, 4 (1981) 79-96.
182. H.G. Pisarski, IJF, 17 (1981) 427-440 [81A48445].
183. D.M. O'Brien and W.G. Ferguson, IJF, 20 (1982) R39-R43.
184. R. Kohno, T. Takami, N. Mori and K. Nagano, WJ, 61 (1982) 373s-380s.
185. J.E. King and J.F. Knott, MS, 15 (1981) 1-6 [81A22201].
186. A.A. Willoughby and P.L. Pratt, Second European Colloquium on Fracture, Darmstadt, October 9-11, 1978 (1978) 144-156 [81V17067].
187. A.A. Willoughby, P.L. Pratt and C.E. Turner, IJF, 17 (1981) 449-466 [82A11252].
188. M.G. Hebsur, K.P. Abraham and Y.V.R.K. Prasad, IJOF, 2 (1980) 147-152.
189. ANON., Department of Energy Report, DOE/ER-0045/5 OTR-12 (1981) [81N75548].
190. F.H. Huang and G.L. Wire, Hanford Engineering Development Laboratory Report HEDL-SA-2474-FP (1981) [82N16224].
191. A.A. Willoughby and S.J. Garwood, IJF, 17 (1981) R11-R15.
192. B.A. Fields and K.J. Miller, Cambridge University Engineering Department Report (1977) [PB82-187972].
193. T.E. Caton and P.W. Holsberg, Ship Materials Engineering Department Research and Development Report, DTNSRDC/SME-81/71 (1982) [AD-B063840L].
194. D.T. Read and H.I. McHenry, National Bureau of Standards Report NBSIR81-1648 (1981) [82N29503].

195. J.A. Joyce and E.J. Czyryca, David Taylor Naval Ship Research and Development Center Report DTNSRDC/SME-81/57 (1981) [82N27474].
196. S.H. Goods, Sandia National Laboratories Report SAND81-8251 (1981) [82N26735].
197. D.K. Verma and J.T. Berry, JEMT, 104 (1982) 262-266.
198. S.C. Lee and F.J. Worzala, MT, 12A (1981) 1477-1484.
199. C. Kim, A.R. Johnson and W.F. Hosford, MT, 13A (1982) 1595-1605.
200. J.H. Underwood and J.J. Zalinka, U.S. Army Armament Research and Development Command Report ARLCB-TR-81018 (1981) [81N30471].
201. A. Mubeen, Institution of Engineers (India), Journal, Mechanical Engineering Division, 60 (1980) 149-152 [81A24575].
202. O. Vosikovsky and A. Rivard, IJOF, 3 (1981) 111-115.
203. Deleted.
204. J.R. Stephens, J.H. Devletian and W.R. Witzke, WJ, 60 (1981) 177s-184s [81A48143].
205. H. Conrad, C. Yin and G.A. Sargent, JMS, 16 (1981) 237-250.
206. J. Toplosky and R.O. Ritchie, Scripta Metallurgica, 15 (1981) 905-908 [81A45098].
207. F.R. Stonesifer and J.M. Krafft, NRL Memo Report 4467 (1981) [81N22162].
208. W.H. Cullen and K. Torronen, NRL Memo Report 4298 (1980) [81N11426].
209. T.A. Prater and L.F. Coffin, Micro and Macro Mechanics of Crack Growth, The Metallurgical Society of AIME (1982) 213-222.
210. R.O. Ritchie, Analytical and Experimental Fracture Mechanics, Sijthoff and Noordhoff (1981) 81-108 [81V28137].
211. T.T. Shih and J.K. Donald, JEMT, 103 (1981) 104-111.
212. V.P. Swaminathan, T.T. Shih and A. Saxena, EFM, 16 (1982) 827-836.
213. D. de G. Jones, Engineering Applications of Fracture Analysis, Pergamon Press (1980) 353-369 [81V13795].
214. D. Slagter and M.A. Lont, The Measurement of Crack Length and Shape During Fracture and Fatigue, Engineering Materials Advisory Services, Ltd. (1980) 270-284 [81V20024].

215. V. Provenzano, K. Torronen, W.H. Cullen and G. Gabetta, Analytical and Experimental Fracture Mechanics, Sijthoff and Noordhoff (1981) 211-222 [81V28137].
216. P. Shahinian and K. Sadananda, NRL Memorandum Report 4495 (1981) [81N23248].
217. M. Mitchell, NASA CR 166295 (1981) [82N19388].
218. S. Suresh and R.O. Ritchie, MS, 16 (1982) 529-538.
219. H. Kobayashi, H. Nakamura and H. Nakazawa, 4th International Conference on Pressure Vessel Technology, 1 (1980) 251-256 [81V31180].
220. K. Iida and M. Kawahara, 4th International Conference on Pressure Vessel Technology, 1 (1980) 257-263 [81V31180].
221. L.A. Simpson, Atomic Energy of Canada Limited Report AECL-5991 (1978).
222. G. Gabetta and C. Fossati, Centro Informazioni Studi Esperienze Report CISE 1705 (1981) [82N17527].
223. B. Tomkins, Creep and Fatigue in High Temperature Alloys, Applied Science Publishers, (1981) 111-143.
224. B. Tomkins, Philosophical Transactions of the Royal Society of London, 299 (1981) 33-41 [81V31785].
225. S.J. Hudak, Jr., JEMT, 103 (1981) 26-35 [81A23004].
226. T. Shoji, H. Takahashi, M. Suzuki and T. Kondo, JEMT, 103 (1981) 298-304 [82A36052].
227. G.C. Salivar, D.L. Creighton and D.W. Hoepfner, EFM, 14 (1981) 337-352.
228. C.J. Poon and D.W. Hoepfner, IJOF, 1 (1979) 141-152.
229. R.P. Wei and R.L. Brazill, The Measurement of Crack Length and Shape During Fracture and Fatigue, Engineering Materials Advisory Services, Ltd. (1980) 190-201 [81V20024].
230. R.P. Wei and G.W. Simmons, Institute of Fracture and Solid Mechanics Report IFSM-80-104 (1980) [81N11200].
231. R.I. Stephens, S.G. Lee and H.W. Lee, IJF, 19 (1982) 83-98.
232. M.H. El Haddad, T.H. Topper and T.N. Topper, JEMT, 103 (1981) 91-96.
233. O. Vardar, JEMT, 104 (1982) 192-199.

234. K. Minakawa, Y. Matsuo and A.J. McEvily, MT, 13A (1982) 439-445.
235. G.R. Yoder, L.A. Cooley and T.W. Crooker, NRL Memo Report 4576 (1981) [81N32247].
236. P.M. Scott, Developments in Fracture Mechanics-1, Applied Science Publishers (1979) 221-258 [81A48576].
237. T.S. Gross and J. Weertman, MT, 13A (1982) 2165-2172.
238. H. Nayeib-Hashemi, F.A. McClintock and R.O. Ritchie, MT, 13A (1982) 2197-2204.
239. R.C. Brown and N.E. Dowling, STP 738, American Society for Testing and Materials (1981) 58-69 [81V27201].
240. J.J. Au and J.S. Ke, STP 733, American Society for Testing and Materials (1981) 202-221 [81A47859].
241. K. Selby, IJOF, 4 (1982) 124-128.
242. W.H. Hartt, STP 761, American Society for Testing and Materials (1982) 91-109 [82V27512].
243. J.K. Musuva and J.C. Radon, 5th International Conference Fracture, Cannes, France, 3 (1982) 1365-1372 [82V12048].
244. J.K. Musuva and J.C. Radon, Second European Colloquium on Fracture, Darmstadt, October 9-11, 1978 (1978) 286-310 [81V17067].
245. P.M. Scott and T.W. Thorpe, FEMS, 4 (1981) 291-309 [82A30946].
246. W.D. Dover and S.J. Holdbrook, IJOF, 2 (1980) 37-43.
247. J.C. Radon, IJOF, 4 (1982) 161-166.
248. J.C. Radon, IJOF, 4 (1982) 225-232.
249. A.F. Greenan, National Engineering Laboratory Report NEL-679 (1982).
250. N.M. Grinberg, IJOF, 4 (1982) 83-95 [82A31498].
251. M.H. El Haddad, T.H. Topper, and B. Mukherjee, Journal of Testing and Evaluation, 9 (1981) 65-81 [81A28648].
252. M.H. El Haddad, T.H. Topper and I.F.C. Smith, Journal of Testing and Evaluation, 8 (1980) 301-307 [81A14739].
253. C.R. Saff and M.S. Rosenfeld, STP 761, American Society for Testing and Materials (1982) 234-252 [82V27512].
254. W.W. Gerberich, Department of Energy Report DOE-ER-10433-2 (1981) [81N25443].

255. W.W. Gerberich, Department of Energy Report DOE-ER-10433-3 (1982).
256. K. Tanaka, S. Matsuoka, V. Schmidt and M. Kuna, 5th International Conference Fracture, Cannes, France, 4 (1982) 1789-1798 [82V12048].
257. A. Ohta, E. Sesaki, M. Nihei, M. Kosuge, M. Kanao and M. Inagaki, IJOF, 4 (1982) 233-237.
258. D. F. Hasson and J.A. Joyce, JEMT, 103 (1981) 133-141 [81A32744].
259. M.E. Fine, Northwestern University Report (1981) [82N26449].
260. M.E. Fine, Northwestern University Report (1980) [81N13157].
261. D.A. Davis and E.J. Czyryca, JPVT, 103 (1981) 314-321.
262. Y. Takeda and C.J. McMahon, Jr., MT, 13A (1982) 111-116.
263. S. Floreen and R.H. Kane, MT, 13A (1982) 145-152.
264. M.S. Starkey and P.E. Irving, IJOF, 4 (1982) 129-136.
265. S. Wastberg, Royal Institute of Technology (Sweden) Report TRITA-HFL-0029 (1980) [82N19596].
266. S. Kawai, EFM, 16 (1982) 857-870.
267. A.S. Salah el din and J.M. Lovegrove, IJOF, 4 (1982) 15-26.
268. B.S. Greenwell and R.N. Parkins, FEMS, 5 (1982) 115-132.
269. H. Sehitoglu and D.L. McDiarmid, IJOF, 2 (1980) 55-60.
270. R.O. Ritchie and S. Suresh, MT. 13A (1982) 937-940.
271. O. Vosikovsky, IJF, 17 (1981) 301-309.
272. L.A. James, Hanford Engineering Development Laboratory Report HEDL-TME 80-71 (1980) [81N18183].
273. W.W. Gerberich and K.A. Peterson, Micro and Macro Mechanics of Crack Growth, The Metallurgical Society of AIME (1982) 1-17 [83A34477].
274. R.P. Gangloff, STP 738, American Society for Testing and Materials (1981) 120-138 [81V27201].
275. R.P. Wei, P.M. Talda and Che-Yu-Li, STP 415, American Society for Testing and Materials (1967) 460-480 [82V13202].
276. R.L. Tobler, D.T. Read and R.P. Reed, STP 743, American Society for Testing and Materials (1981) 250-268 [82V11353].

277. S.G. Sampath, I.S. Abou-Sayed, D. Broek, C. Marschall, A. Zahoor and M.F. Kanninen, 5th International Conference Fracture, Cannes, France, 4 (1982) 1759-1767 [82V12048].
278. W.J. Mills, Hanford Engineering Development Laboratory Report HEDL-TME-81-52 (1982) [82N33517].
279. D.T. Read and R.P. Reed, Cryogenics, 21 (1981) 415-417.
280. F.R. Schneider, Jr., Advances in Cryogenic Engineering Materials, 28 (1982) 865-871.
281. E.N.C. Dalder, O.W. Seth and T.A. Whipple, Advances in Cryogenic Engineering Materials, 28, (1982) 839-852.
282. T.A. Whipple, H.I. McHenry and D.T. Reed, WJ, 60 (1981) 72s-78s.
283. R.E. Gold, W.A. Logsdon, G.E. Grotke and B. Lustman, Advances in Cryogenic Engineering Materials, 28 (1982) 759-770.
284. W.A. Logsdon, G.E. Grotke, R.E. Gold and B. Lustman, Advances in Cryogenic Engineering Materials, 28 (1982) 771-780.
285. J.H. Schmidt and M. Katcher, Fracture and Failure, American Society for Metals (1981) 15-33 [82V10583].
286. J.M. Wright and M.F. Jordan, Metals Technology, 7 (1980) 473-482 [81A16873].
287. E.N.C. Dalder and M. Greenlee, Advances in Cryogenic Engineering Materials, 28 (1982) 883-892.
288. V. Provenzano, C.M. Gilmore, F.A. Smidt and J.R. Hawthorne, NRL Memo Report 4696 (1981) [82N21314].
289. S.H. Smith, N.D. Ghadiali, A. Zahoor and M.R. Wilson, STP 761, American Society for Testing and Materials (1982) 445-474 [82V27512].
290. H.J. Rack, Sandia National Laboratories Report SAND80-2302 (1981) [81N23260].
291. V.P. Raghupathy, V. Srinivasan, H. Krishnan and M.N. Chandrasekharaiah, JMS, 17 (1981) 2112-2126.
292. D.A. Hale, J.D. Heald, R.M. Horn, C.W. Jewett, J.N. Kass, H.S. Mehta, S. Ranganath and S.R. Sharma, Electric Power Research Institute Report EPRI-NP-2472, 2 (1982) [83N23639].
293. G. Marci, STP 743, American Society for Testing and Materials (1981) 147-166 [82V11353].
294. A. Saxena and T.T. Shih, 5th International Conference Fracture, Cannes, France, 5 (1982) 2403-2412 [82V12048].

295. L.A. James, STP 738, American Society for Testing and Materials (1981) 45-57 [81V27201].
296. Y. Asada, R. Yuuki, D. Sunamoto, T. Sakon, K. Tokimasa, Y. Makino, M. Kitagawa and K. Shingai, 4th International Conference on Pressure Vessel Technology, 1 (1980) 347-352 [81V31180].
297. D.J. Michel, Micro and Macro Mechanics of Crack Growth, The Metallurgical Society of AIME (1982) 185-198.
298. H.W. Liu and J.J. McGowan, AFWAL-TR-81-4036 (1981) [81N33513].
299. H.W. Liu and J.J. McGowan, Scripta Metallurgia, 15 (1981) 507-512 [81A34852].
300. D.A. Mervyn and A. M. Ermi, Institute of Electrical and Electronics Engineers Pub. No. 79CH1441-5 NPS (1979) [81A19204].
301. L.K. Severud, JPVT, 103 (1981) 267-280.
302. K. Krompholz, H. Huthmann, E.D. Grosser and J.B. Pierick, EFM, 16 (1982) 809-819.
303. K. Sadananda and P. Shahinian, Micro and Macro Mechanics of Crack Growth, The Metallurgical Society of AIME (1982) 119-130 [83A34485].
304. R.E. Johnson, NASA CR 165868 (1982) [82N22343].
305. A.M. Ermi, R.E. Bauer, B.A. Chin and J.L. Straalsund, JEMT, 103 (1981) 240-245.
306. D.J. Marsh, FEMS, 4 (1981) 179-195.
307. M.S. Starkey and R.P. Skelton, FEMS 5 (1982) 329-341 [83A27856].
308. P.K. Liaw, J. Anello and J.K. Donald, MT, 13A (1982) 2177-2189.
309. E.K. Tschegg, C. Tauschitz and S.E. Stanzl, MT, 13A (1982) 1483-1489 [82A40337].
310. R.M. Duncan and B.H. Hanson, The Selection and Use of Titanium, Oxford University Press (1980) [81V20151].
311. H.J. Rack and T.J. Headley, Scripta Metallurgica, 14 (1980) 1211-1216 [81A13396].
312. A.K. Chakrabarti, M. Doner and R.W. Stusrud, Paper F79-16, Metallurgical Society of AIME (1979) [81A14774].
313. R.F. Vaughan, Titanium '80 Science and Technology, Metallurgical Society of AIME (1980) 2423-2430 [81A41660].
314. C.G. Rhodes, M.R. Mitchell and J.C. Chesnutt, Rockwell International Science Center Report SC5227.1FR (1982) [82N33499].

- 315. H. Terada, E. Nakai and H. Takamatsu, Titanium '80 Science and Technology, Metallurgical Society of AIME (1980) 1607-1615 [81A41608].
- 316. W.A. Baeslack, III, D.W. Becker and F.H. Froes, Titanium '80, Science and Technology, Metallurgical Society of AIME (1980) 2369-2378 [81A41655].
- 317. M. Zako, T. Kawashima, H. Aono, K. Jimboh, H. Ohnabe and T. Miyoshi, STP 761, American Society for Testing and Materials (1982) 408-423 [82V27512].
- 318. W. Schutz, Practical Applications of Fracture Mechanics, AGARDograph No. 257 (1980) 6-1 - 6-52 [82N19571].
- 319. G.R. Yoder, L.A. Cooley and T. W. Crooker, NRL Memo Report 4678 (1981) [82N18377].
- 320. G.R. Yoder, L.A. Cooley and T.W. Crooker, NRL Memo Report 4758 (1982) [82N24330].
- 321. R.W. Gardiner, Paper F79-15, The Metallurgical Society of AIME (1979) [81A14773].
- 322. R.E. Smelser, Materials Science and Engineering, 46 (1980) 175-190 [81A19574].
- 323. H. Terada and Y. Kakuta, EFM, 16 (1982) 279-286 [82A23768].
- 324. G.D. Swanson, Bendix Corporation Report BDX-613-2625 (1981) [81N31586].
- 325. K.C. Wu, WJ, 60 (1981) 219s-226s [82A15300].
- 326. R.L. Jones and T.V. Duggan, IJOF, 3 (1981) 89-100 [81A30424].
- 327. S. Takezono and M. Satoh, JEMT, 104 (1982) 257-261 [83A10647].
- 328. N.R. Moody and W.W. Gerberich, FEMS, 5 (1982) 57-70 [82A36152].
- 329. G.R. Yoder, L.A. Cooley and T.W. Crooker, Advances in Materials Technology in the Americas - 1980, 2, The American Society of Mechanical Engineers (1980) 135-140 [81V27745].
- 330. R.J. Puigh, R.E. Bauer, A.M. Ermi and B.A. Chin, Hanford Engineering Development Laboratory Report HEDL-SA-2475 (1981) [82N12481].
- 331. A.J. McEvily, Air Force Office of Scientific Research Report AFOSR-TR-80-1347 (1980) [81N17239].
- 332. J.A. Ruppen and A.J. McEvily, STP 733, American Society for Testing and Materials (1981) 32-50 [81A47853].

333. P.S. Pao, R.J. Lederich and S.M.L. Sastry, Micro and Macro Mechanics of Crack Growth, The Metallurgical Society of AIME (1982) 71-82 [83A34481].
334. J.C. Chesnutt, N.E. Paton and M.R. Mitchell, 5th International Conference Fracture, Cannes, France, 1 (1982) 337-344 [82V12048].
335. G.R. Yoder, L.A. Cooley and T.W. Crooker, STP 738, American Society for Testing and Materials (1981) 85-102 [81V27201].
336. S.W. Hopkins and C.A. Rau, Jr., STP 738, American Society for Testing and Materials (1981) 255-270 [81V27201].
337. R.J.H. Wanhill and H. Doker, National Aerospace Laboratory Report NLR MP 78002 U (1977) [81N70062].
338. C.H. Cook, H.E. Johnson and C.E. Spaeth, AFWAL-TR-81-2045 (1981) [82N17176].
339. W.T. Highberger, G.R. Chanani and G.V. Scarich, Materials 1980, Society for the Advancement of Material and Process Engineering (1980) 539-553 [81A43636].
340. B.E. Powell, T.V. Duggan and R. Jeal, IJOF, 4 (1982) 4-14 [82A21170].
341. R.E. Ricker and D.J. Duquette, Micro and Macro Mechanics of Crack Growth, The Metallurgical Society of AIME (1982) 29-47.
342. D.B. Dawson, MT, 12A (1981) 791-800 [81A37584].
343. K. Jatavallabhula and W. W. Gerberich, FEMS, 4 (1981) 173-178 [82A16693].
344. S.R. Holdsworth and W. Hoffelner, in High Temperature Alloys for Gas Turbines 1982, D. Reidel Publishing Co. (1982) 345-368 [83A21464].
345. S.R. Holdsworth, Superalloys 1980, American Society for Metals (1980) 375-383 [81A49207].
346. W.J. Mills, STP 733, American Society for Testing and Materials (1981) 98-114 [81A47855].
347. P.J. Postaus and R.H. Jeal, Rolls-Royce Limited Report PNR-90059 (1980) [82N21323].
348. A. Blom, Linkoping Institute of Technology Report LiTH-IKP-S-136 (1980) [81N29461].
349. B. Kirkwood and J.R. Weertman, Micro and Macro Mechanics of Crack Growth, The Metallurgical Society of AIME (1982) 199-212 [83A34489].
350. S. Floreen and R. H. Kane, Superalloys 1980, American Society for Metals (1980) 595-604 [81A49226].

- 351. A.E. Gemma, F.X. Ashland and R.M. Masci, *Journal of Testing and Evaluation*, 9 (1981) 209-215 [81A41164].
- 352. H. Tsuji and T. Kondo, *Japan Atomic Energy Research Institute Report JAERI-M-8787* (1980).
- 353. J. Gayda and R.V. Miner, *NASA TM-81740* (1981) [81N23244].
- 354. J.J. McGowan and H.W. Liu, *JEMT*, 103 (1981) 246-252.
- 355. G.S. Was, H.H. Tischner, R.M. Latanision and R.M. Pelloux, *MT*, 12A (1981) 1409-1418 [81A44803].
- 356. A. Saxena, R.S. Williams, and T.T. Shih, *STP 743*, American Society for Testing and Materials (1981) 86-99 [82V11353].
- 357. J.N. Vincent and L. Remy, in *High Temperature Alloys for Gas Turbines*, 1982, D. Reidel Publishing Co. (1982) 633-643 [83A21478].
- 358. L.A. James and W.J. Mills, *STP 738*, American Society for Testing and Materials (1981) 70-82 [81V27201].
- 359. L.A. James, *JEMT*, 103 (1981) 234-239.
- 360. W. Höffelner and M.O. Speidel, *5th International Conference Fracture, Cannes, France*, 5 (1982) 2431-2438 [82V12048].
- 361. H.W. Grunling, K.H. Kecenburg and K.K. Schweitzer, in *High Temperature Alloys for Gas Turbines*, 1982, D. Reidel Publishing Co. (1982) 507-543 [83A21470].
- 362. W. Höffelner and M.O. Speidel, *Behavior of High Temperature Alloys in Aggressive Environments*, *EUR 6814* (1980) 993-1004 [81A26496].
- 363. W. Höffelner and M.O. Speidel, *Corrosion and Mechanical Stress at High Temperatures*, *Applied Science Publishers* (1981) 275-287 [81A46301].
- 364. W. Höffelner, *MT*, 13A (1982) 1245-1255 [82A37911].
- 365. F. Gabrielli and R.M. Pelloux, *MT*, 13A (1982) 1083-1090 [82A34975].
- 366. J.E. King, *FEMS*, 5 (1982) 177-188 [83A17897].
- 367. J.E. King, *MS*, 16 (1982) 345-355 [82A39848].
- 368. S. Floreen and C.J. White, *MT*, 12A (1981) 1973-1979 [82A13408].
- 369. J.F. McCarver and R.O. Ritchie, *Lawrence Berkeley Laboratory Report LBL-13453* (1981) [82N28422].
- 370. K. Sadananda and P. Shahinian, *MT*, 12A (1981) 343-351 [81A24113].
- 371. Y. Higo, A.C. Pickard and J.F. Knott, *MS*, 15 (1981) 233-240 [81A38595].

- 372. P.K. Liaw, T.R. Leax, R.S. Williams and M.G. Peck, MT, 13A (1982) 1607-1618.
- 373. A. Varschavsky and E. Donoso, Advances in Materials Technology in the Americas - 1980, 2, The American Society of Mechanical Engineers (1980) 141-145 [81V27745].
- 374. N.M. Grinberg and V.A. Serdyuk, IJOF, 3 (1981) 143-148.
- 375. M.P. Puls, L.A. Simpson and R. Dutton, Fracture Problems and Solutions in the Energy Industry, Pergamon Press (1982) 13-25 [82V25488].
- 376. G. Chalant and L. Reme, EFM, 16 (1982) 707-720 [82A36789].
- 377. I. Roman and D. Jinchuk, FEMS, 5 (1982) 71-76 [82A36153].



Report Documentation Page

1. Report No. NASA TM-102646		2. Government Accession No.		3. Recipient's Catalog No.	
4. Title and Subtitle A Compendium of Sources of Fracture Toughness and Fatigue Crack Growth Data for Metallic Alloys - Part IV				5. Report Date May 1990	
				6. Performing Organization Code	
7. Author(s) C. Michael Hudson and John J. Ferrainolo				8. Performing Organization Report No.	
				10. Work Unit No. 505-63-01-05	
9. Performing Organization Name and Address NASA Langley Research Center Hampton, VA 23665-5225				11. Contract or Grant No.	
				13. Type of Report and Period Covered Technical Memorandum	
12. Sponsoring Agency Name and Address National Aeronautics and Space Administration Washington, DC 20546-0001				14. Sponsoring Agency Code	
15. Supplementary Notes					
16. Abstract <p>A COLLECTION OF SOURCES PRESENTED</p> <p>This technical memorandum presents sources of fracture toughness and fatigue crack growth data for metallic alloys.</p>					
17. Key Words (Suggested by Author(s)) Fracture toughness, fatigue crack growth, data			18. Distribution Statement Unclassified - Unlimited Subject Category 26		
19. Security Classif. (of this report) UNCLASSIFIED		20. Security Classif. (of this page) UNCLASSIFIED		21. No. of pages 37	22. Price A03

